Mumbai University

Question Paper

[IDOL – Revised Course]

(May – 2016)

Digital

Signals and Systems

Time: 3 Hours **Total Marks:** 100

N.B.: **(1)** *All Question are Compulsory.*
(2) *Make Suitable Assumptions Wherever Necessary And State The Assumptions Made.*
(3) *Answer To The Same Question Must Be Written Together.*
(4) *Number To The Right Indicates Marks.*
(5) *Draw Neat Labeled Diagrams Wherever Necessary.*
(6) *Use of Non – Programmable Calculator is allowed.*

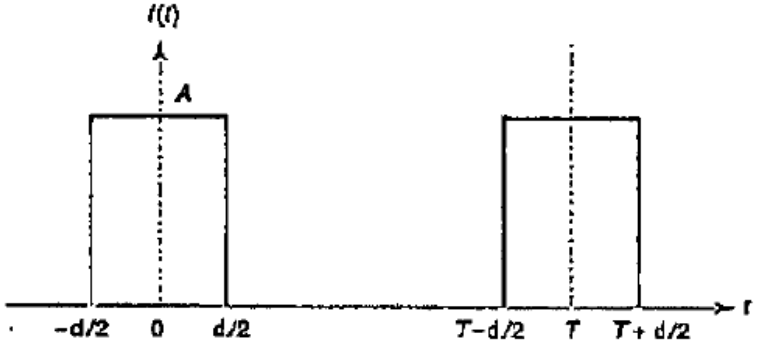
Q.1 ATTEMPT ANY TWO QUESTIONS: (10 MARKS)

(A) What are the advantages of digital filters? Explain. **(5)**

(B) Check whether the system given by $F[x(n)] = e^{x(n)}$ is linear or not. **(5)**

(C) How are signals classified? Explain. **(5)**

(D) Deduce the Fourier series for the waveform of a positive going rectangular pulse train shown. **(5)**



Q.2 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Determine the Fourier transform of Signum function and plot amplitude and phase spectra. **(5)**

(B) State any ten properties of unit impulse function $^{\delta}(t)$. **(5)**

(C) What is meant by sampling? State sampling theorem. **(5)**

(D) Write a note on Dirichlet's conditions. **(5)**

(E) With neat labelled block program explain how analog signal gets converted into digital signals. **(5)**

(F) Find the Fourier transform for the signal described as: **(5)**

$$\begin{aligned} f(t) &= 1 && -2 \le t \le -1 \\ &= 2 && -1 \le t \le 1 \\ &= 1 && 1 \le t \le 2 \end{aligned}$$

Q.3 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Find the Laplace transform of $Sin\ at\ .Sin\ bt$ **(5)**

(B) Obtain Laplace transform for step and Impulse Responses of a series R-L Circuit. **(5)**

(C) Discuss final value theorem in Laplace transform domain. **(5)**

(D) Find the Laplace Transform of: **(5)**
(i) $e^{-t} \sin 4t$
(ii) $e^{2t} + 2te^{-2t} - t^2$

(E) Find inverse Laplace transform of $F_{2(s)} = \frac{3e^{-\frac{s}{2}}}{s^2(s^2+2)}$ **(5)**

(F) Explain the significance of pole-zero diagram in circuit analysis? How can the time domain response be determined from pole-zero plot? **(5)**

[Turn Over]

Q.4 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) What are the condition for z-Transform to exist? Explain. **(5)**

(B) Determine the Z-Transform and the region of convergence of **(5)**

$$x(n) = \begin{pmatrix} 2^n & n & \geq 0 \\ 0 & n & > 0 \end{pmatrix}$$

(C) Determine the convolution of the two sequences $x(n) = \{2,1,0,0,5\}$ and $h(n) = \{2,2,1,1\}$ **(5)**

(D) Compare the properties of two-sided z-transform with those of one-sided z-Transform. **(5)**

(E) Using convolution find $x(n)$ if $X(z)$ is given by: **(5)**

$$x(n) = \frac{1}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 + \frac{1}{4}z^{-1}\right)}$$

(F) Find $x(n)$ if $X(z) = \frac{z+3}{z^7\left(z-\frac{1}{2}\right)}$ **(5)**

Q.5 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) What is convolution in Linear Time Invariant System? What are the properties of convolution? **(5)**

(B) Check whether the following systems are BIBO stable or not **(5)**

(i) $y(n) = ax(n+1) + bxh(n-1)$

(ii) $y(n) = ax(n).x(n-1)$

(C) The output $y(n)$ for an Linear Time Invariant system to the input $x(n)$ is $y(n) = x(n) - 2x(n-1) + x(n-2)$. Compute the magnitude and phase of the frequency response of the system for $|\omega \geq \pi|$ **(5)**

(D) Compute the response of the system $y(n) = 0.7y(n-1) - 0.12y(n-2) + x(n-1) + x(n-2)$ to the input $x(n) = nu(n)$ **(5)**

(E) What is frequency response? What are the properties of frequency response? **(5)**

(F) Obtain Frequency Response for $y(n) = x(n) + 10y(n-1)$ with initial condition $y(-1) = 0$. **(5)**

Q.6 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Determine DFT of the sequence $x(n) = \begin{cases} 1 \\ 4 & 0 \leq n \leq 2 \\ 0 & otherwise \end{cases}$ **(5)**

(B) Define Discrete Time Fourier Transform (DTFT) and Inverse Discrete Time Fourier Transform (IDTFT). Explain the difference between Discrete Fourier Transform (DFT) and Discrete Time Fourier Transform (DTFT). **(5)**

(C) Consider two periodic sequences $x(n)$ and $y(n)$ with period M and N respectively. The sequence $w(n)$ is defined as $y(n) = x(n) + y(n)$. Show that $w(n)$ is periodic with period MN. **(5)**

(D) Obtain $X(k)$ for the sequence $x(n) = \{1,2,3,4,4,3,2,1\}$ using Decimation-in-Time (DIT), Fast Fourier Transform (FFT) Algorithm. **(5)**

(E) Compute Linear and Circular Periodic Convolutions of the sequence $x_1(n) = \{1,1,2,2\}$ and $x_2(n) = \{1,2,3,4\}$ using DFT. **(5)**

(F) Define discrete Fourier transform. Explain any five properties of discrete Fourier transform. **(5)**

Q.7 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) What is an IIR filter? Compare its characteristics with an FIR filter. **(5)**

(B) Explain the procedure for designing an FIR Filter using Kaiser Window. **(5)**

(C) Explain the effects of windowing. Define Rectangular and Hamming Window functions. **(5)**

(D) Describe elliptical filter in detail. **(5)**

(E) Write a short note on Chebyshev filters. **(5)**

(F) Write a short note on Butterworth filters. **(5)**